SEA UNSEEN

Microscopic images of ocean life

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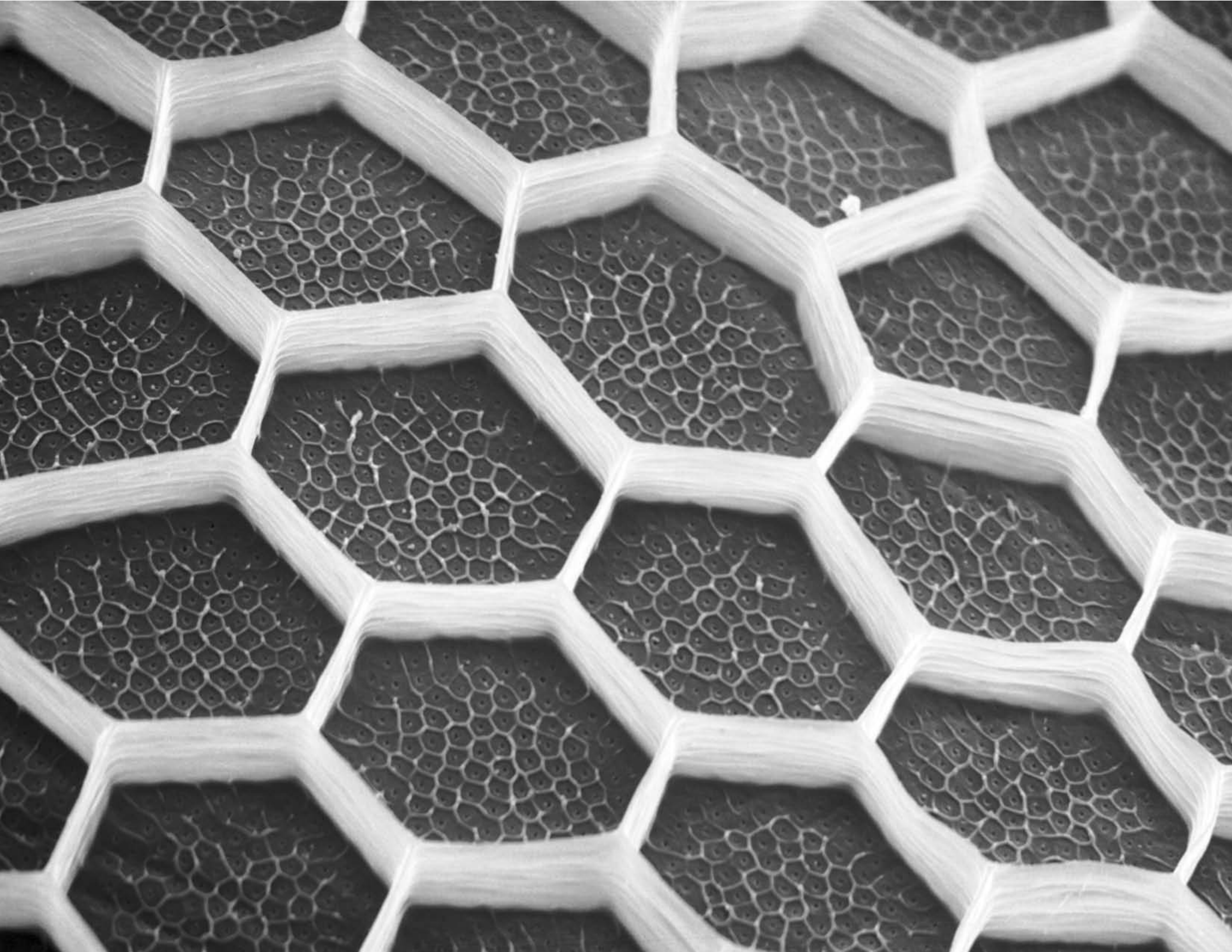

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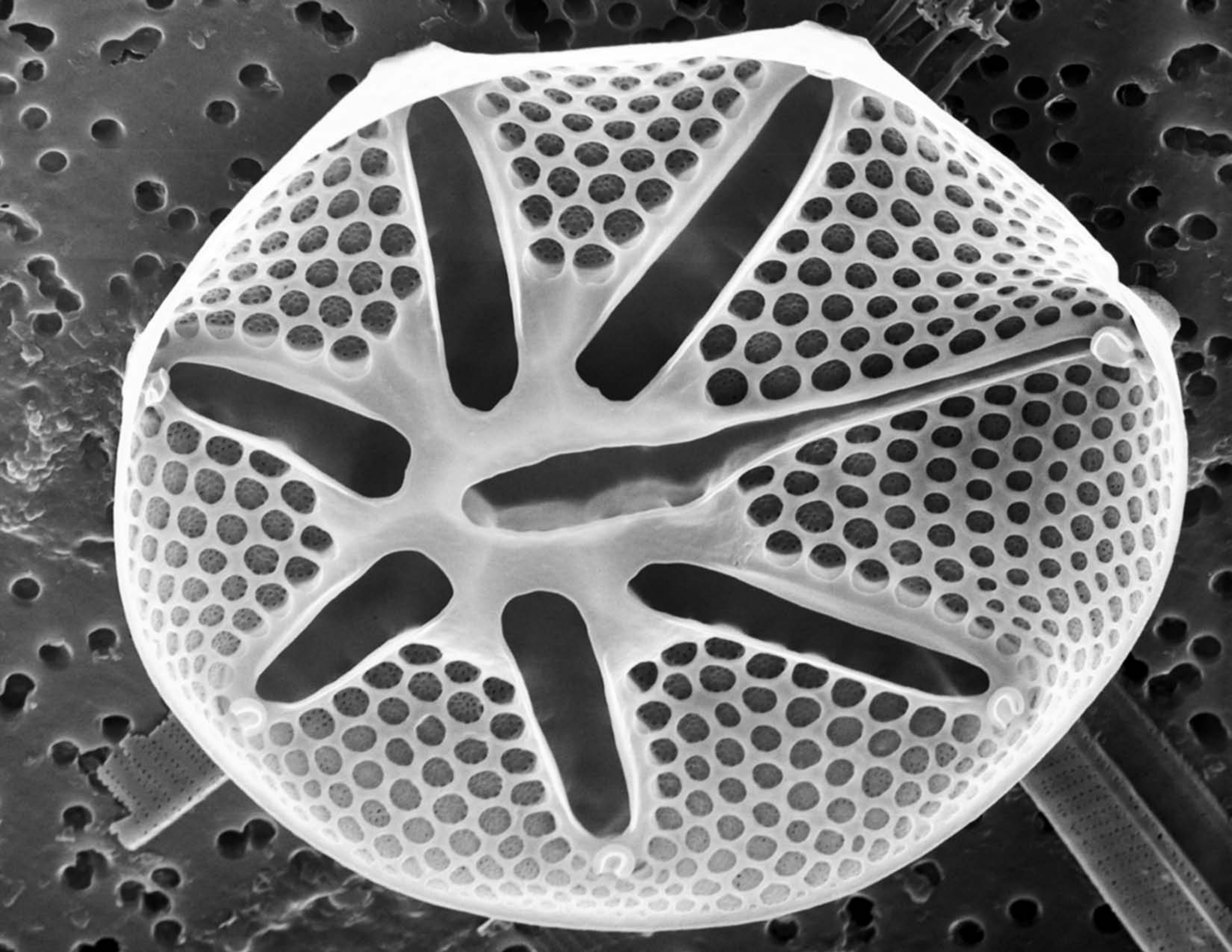
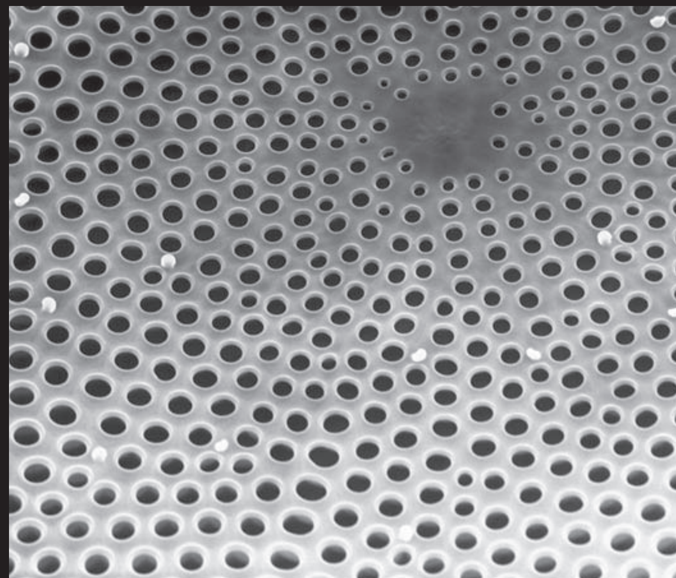
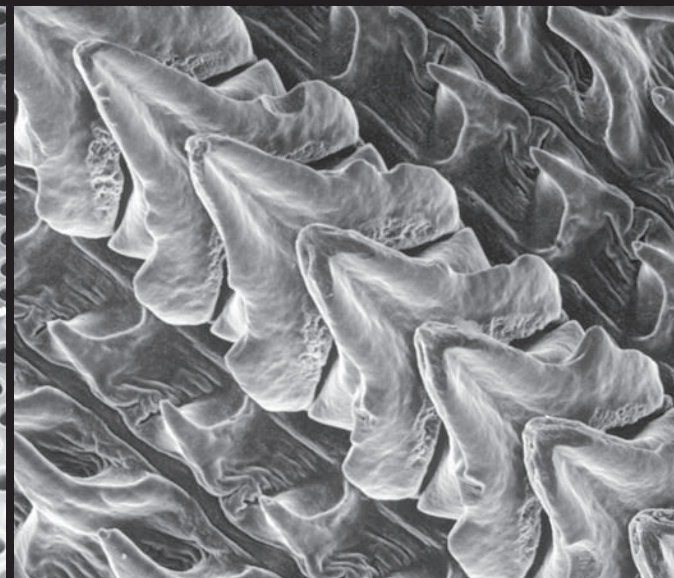
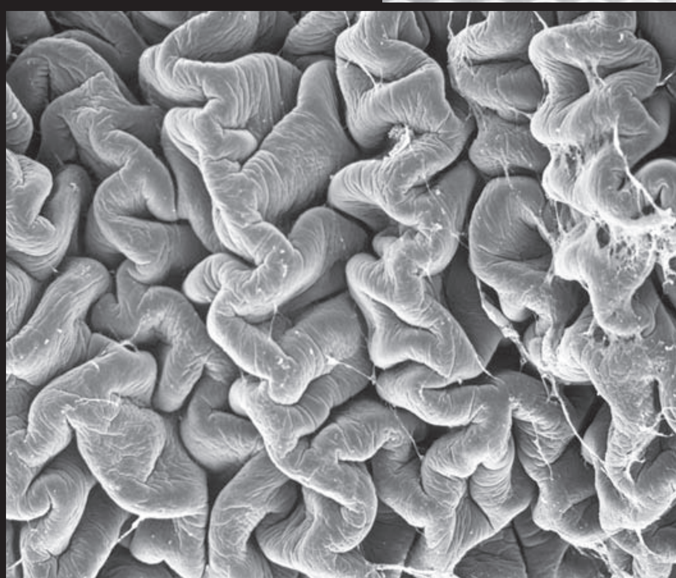


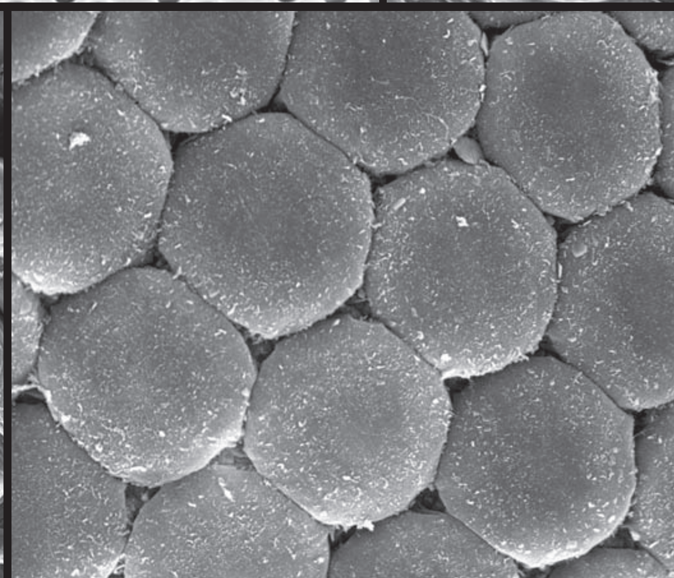
PATTERNS IN NATURE

Life in the ocean produces amazing microscopic patterns - what do these photos remind you of?









Life in the ocean produces amazing microscopic patterns - what do these photos remind you of?

PATTERNS IN NATURE

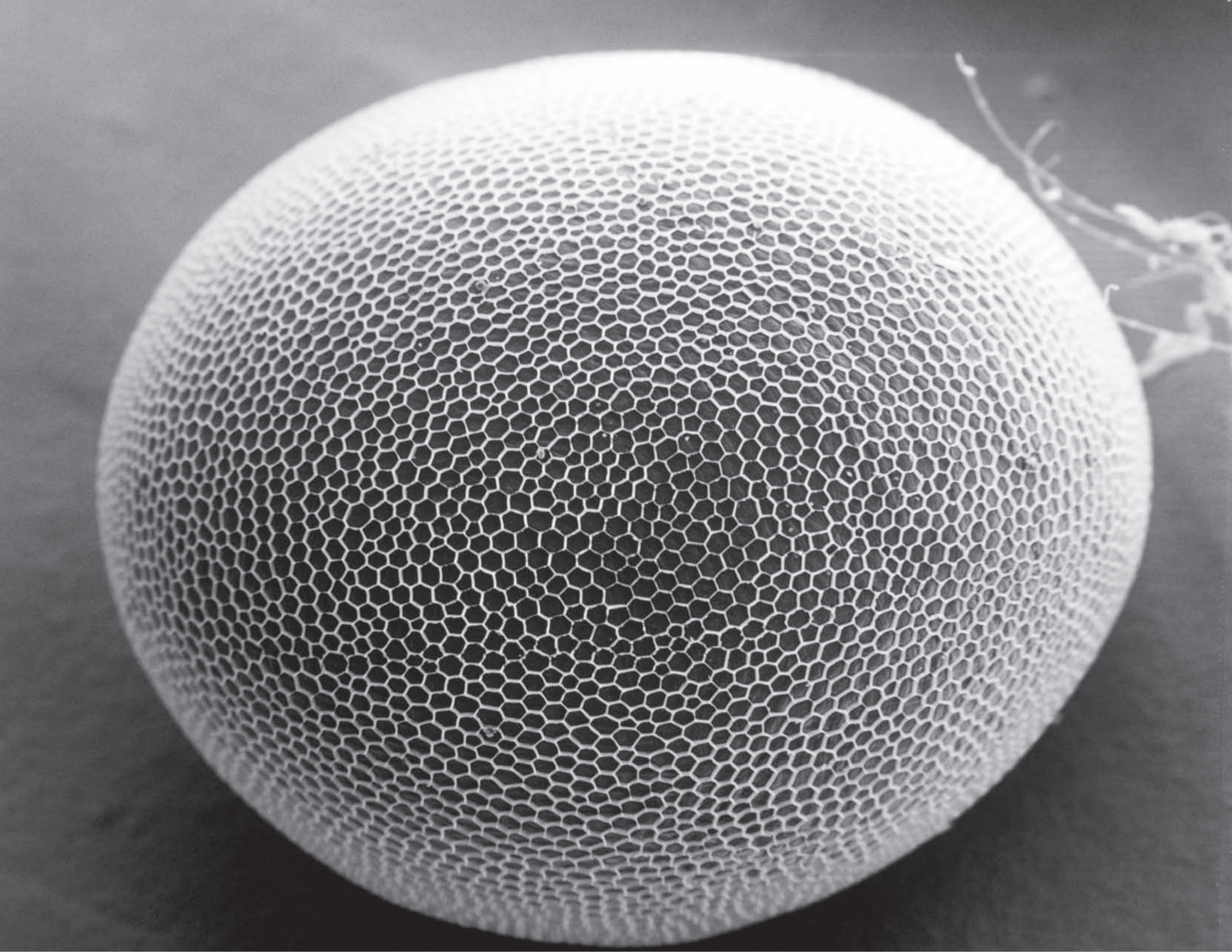
SCANNING ELECTRON MICROSCOPE

What is a scanning electron microscope?

- Unlike most classroom microscopes that use light to form magnified images, electron microscopes use electrons.
- A scanning electron microscope (SEM) scans the sample with a beam of electrons to make a three-dimensional (3D) image of the surface.
- An electron is a tiny, negatively charged particle. A flow of electrons is an electrical current.
- The tiny size of electrons allows electron microscopes to magnify images thousands of times greater than what can be seen with microscopes that use light.
- Ordinary microscopes that use light can magnify from 4 to 1000 times.
- SEMs can magnify up to 300,000 times, but most biological samples are viewed at magnifications of less than 100,000 times.

How does a scanning electron microscope work?

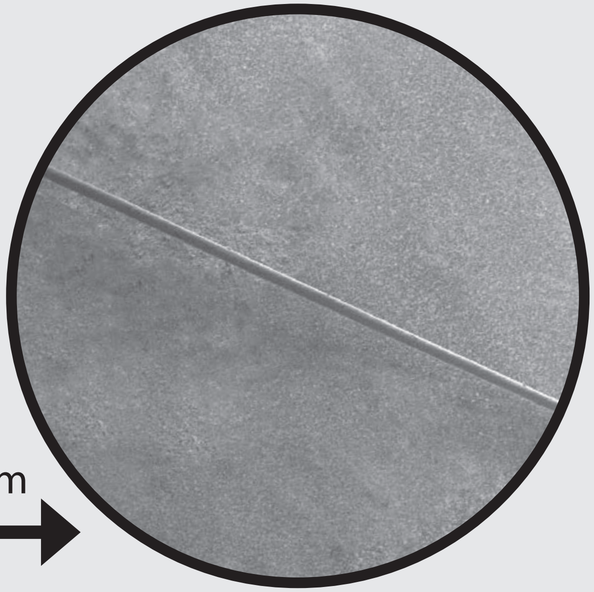
- SEMs examine samples in a chamber with no air (a vacuum) because air particles scatter the electrons.
- A biological sample must be carefully dried before it can be put in a vacuum. Otherwise, the liquid inside will cause the sample to explode.
- Biological samples are covered with a thin layer of metal such as gold or palladium.
- The electrons interact with the metal on the sample surface, then are collected and sent to a screen similar to a television.
- SEM images are black and white, because electron wavelengths are shorter than the wavelengths at which we see color.



MAGNIFICATION:
DO YOU SEE MORE OR LESS?

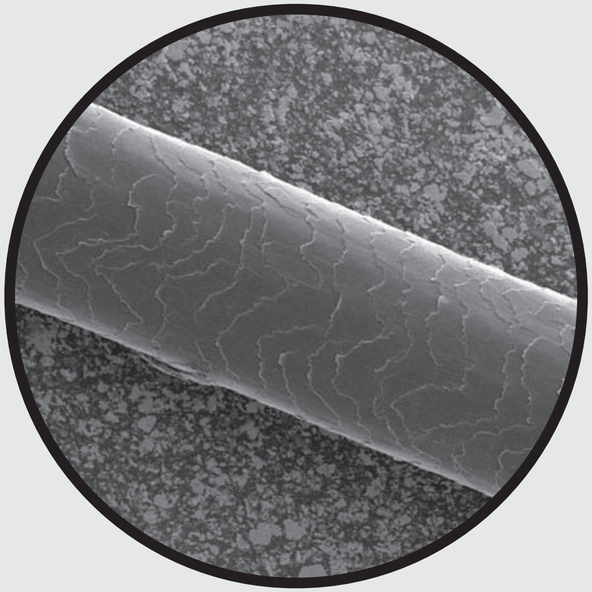
Each of these pictures shows a smaller part of the previous picture, but in more detail. So you do see more features, but you see less of the overall object.

Look at a hair on your head. If you take a piece of hair that is 2.5 mm (1/10 inch) and magnify it to 30x in the SEM, it will look like this:

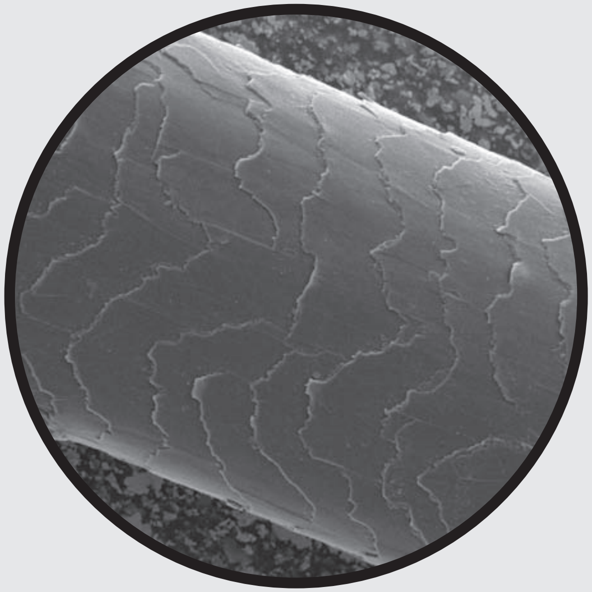


30X

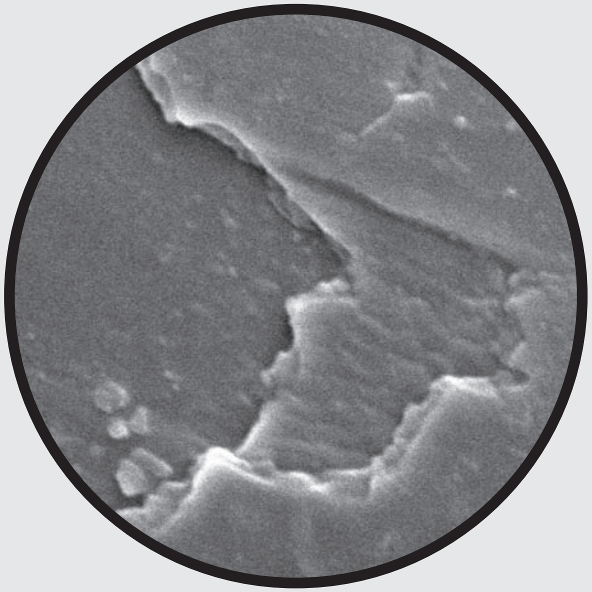
The SEM can zoom in even closer: look at these pictures of a hair at 500x, 1000x, and 10,000x the actual size!



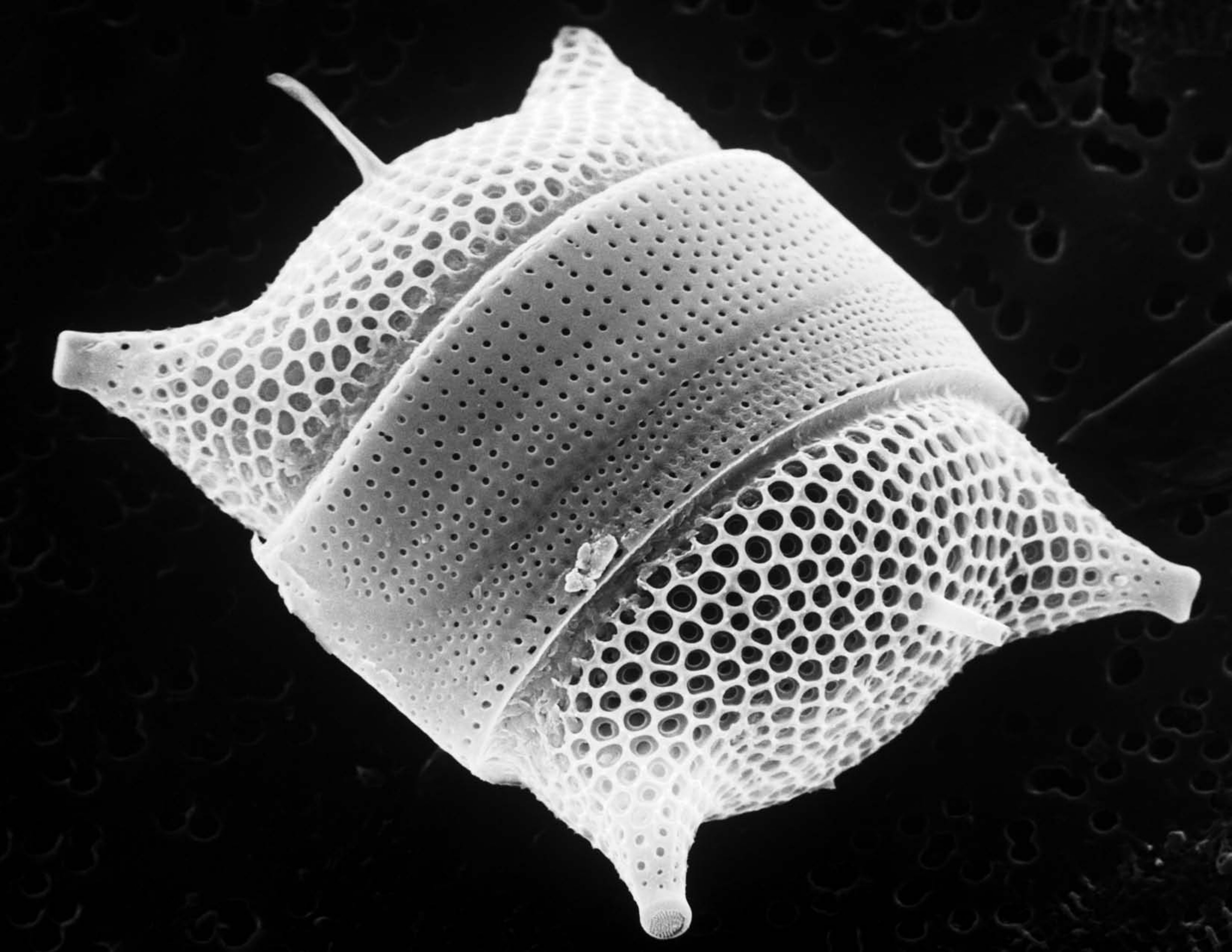
500X



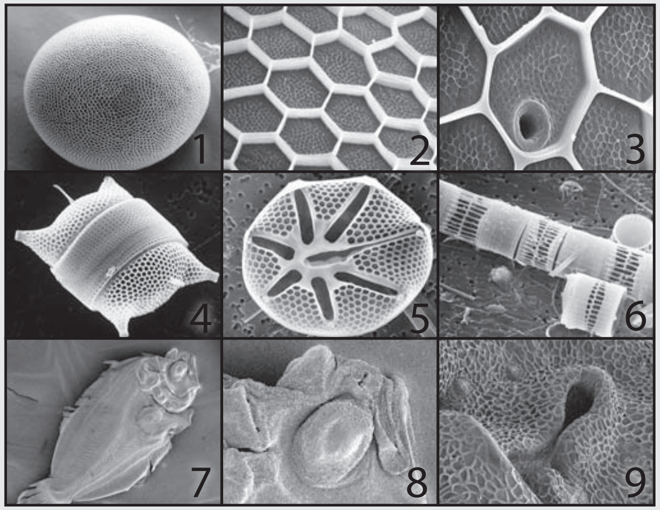
1000X

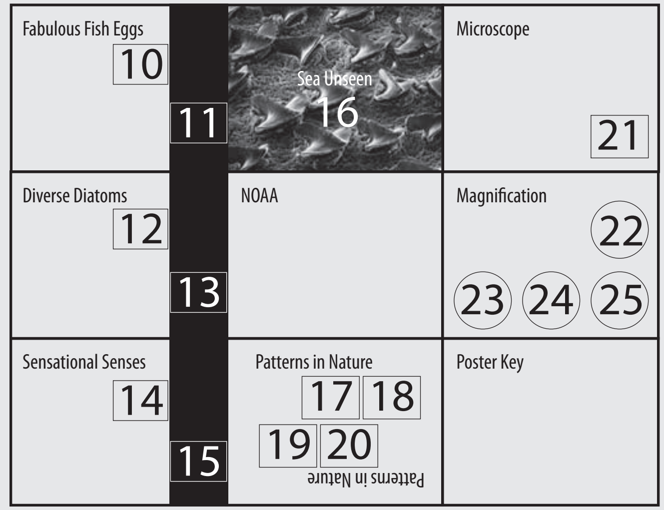


10,000X



POSTER KEY





BIG IMAGES:

1. C-O sole egg. 200X
2. Close view of the C-O sole egg surface. 2100X
3. Micropyle of the C-O sole egg. 4000X
4. *Odontella*, a type of diatom. 3600X
5. Inside surface of *Asteromphalus*, a diatom. 4800X
6. *Skeletonema*, a type of diatom. Several individuals are connected together in a chain. 4800X
7. Six week-old California halibut (about 0.5 cm long). 40X
8. Nare in a six week-old California halibut. Each fish nose has two nares, like nostrils. The other nare is located on the other side of the head. 160X
9. Developing nare of a six week–old California halibut. The sides of the nare are growing together and will fuse in the middle, leaving an opening at each end. Three neuromasts are also present. 1300X

Take a closer look!
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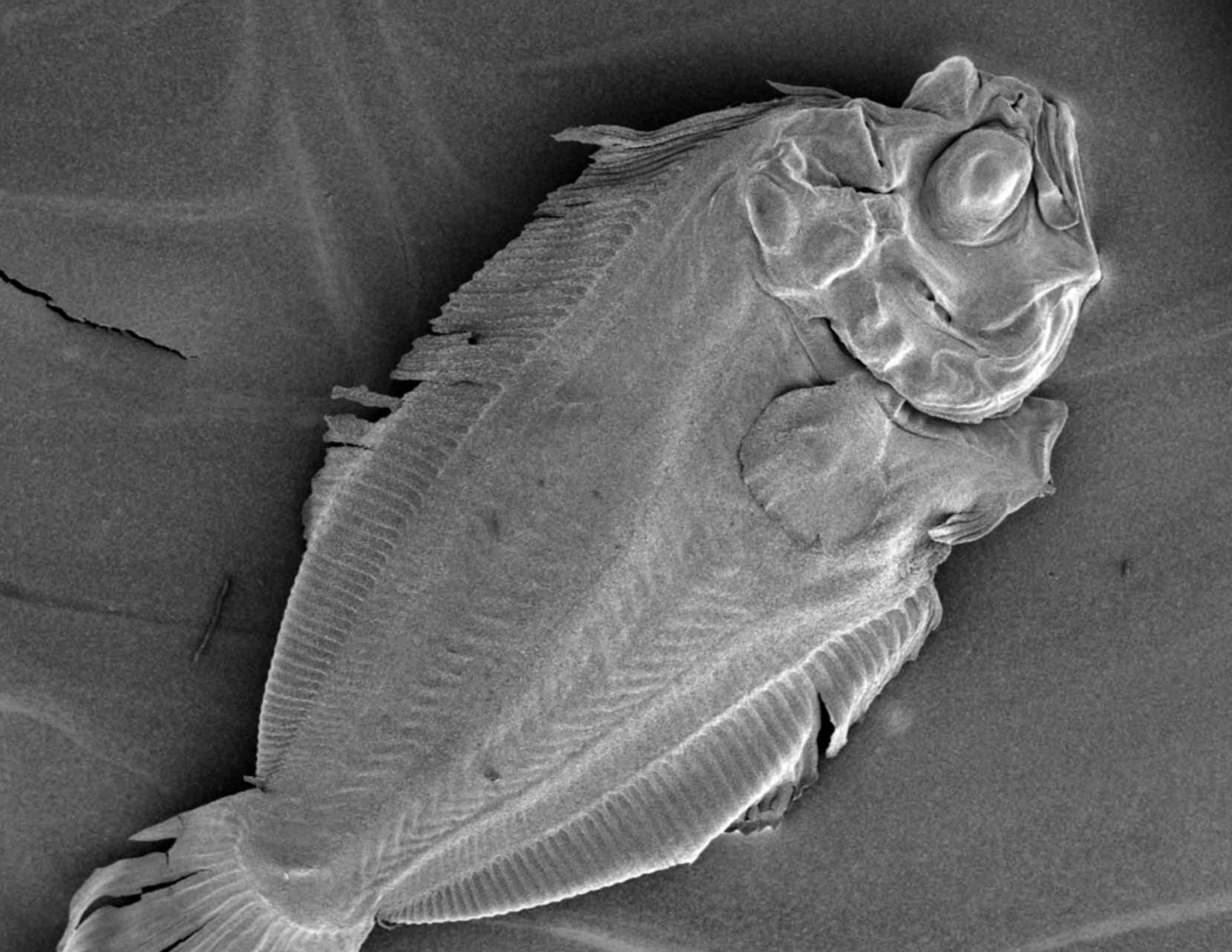
INFORMATIONAL PANELS:

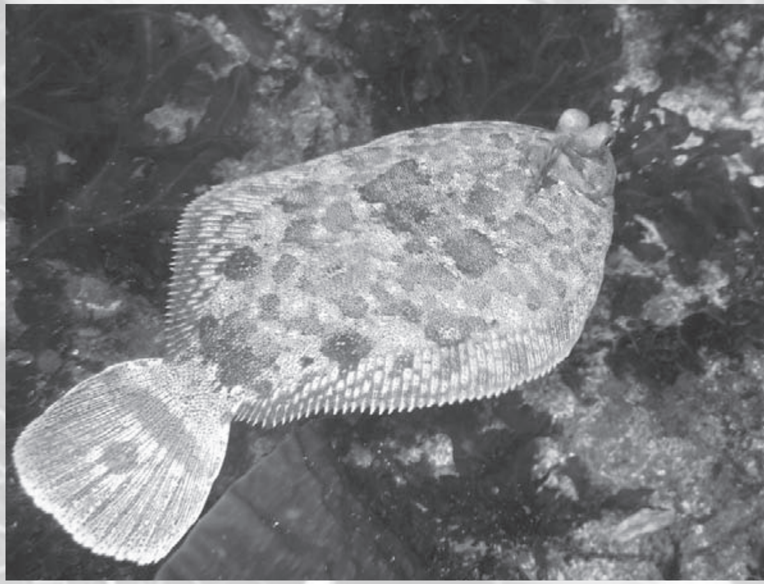
10. C-O sole.
11. Sperm in the micropyle of a pink salmon egg. 3500X
12. Two halves of the diatom *Asteromphalus*, slightly offset. 1800X
13. Three *Skeletonema* diatoms in a chain. 2600X
14. Rosette inside the nare or nostril of a one-year old Chinook salmon. The rosette is a folded structure that contains thousands of sensory cells. 50X
15. Neuromast of a six-week-old halibut, with sensory cilia (hairs) in the center. 2100X
16. Tiny toothlike structures called denticles on the skin of the Pacific spiny dog-fish shark. 1200X
17. Texture on a disc-shaped diatom. 2400X
18. Radula (rasping tongue) of a red octopus. 300X
19. Inside the intestine of an English sole. 2500X
20. Lenses on the compound eye of a baby crab. 1500X
21. Carla Stehr and SEM.

22-25. Magnification: Human hair. 22. 30X; 23. 500X; 24. 1000X; 25. 10,000X



FABULOUS FISH EGGS

Fish eggs are an important part of the ecosystem, not only as future fish, but as a food source for many other organisms. Fish eggs come in many shapes and sizes. Some eggs have an intricate pattern on the surface.



- The geometric pattern on the surface of the C-O sole egg is created by the compression of cells on the outer layer.
- Scientists don't know the function of the amazing pattern on these eggs.

How might this pattern be an adaptation for the C-O sole?
- The layer might make the egg stronger.
- The layer could help the egg float.
- Scientists have tested these hypotheses, but the question is still unanswered.

What are other ways that fish eggs are adapted to survive in their environment?

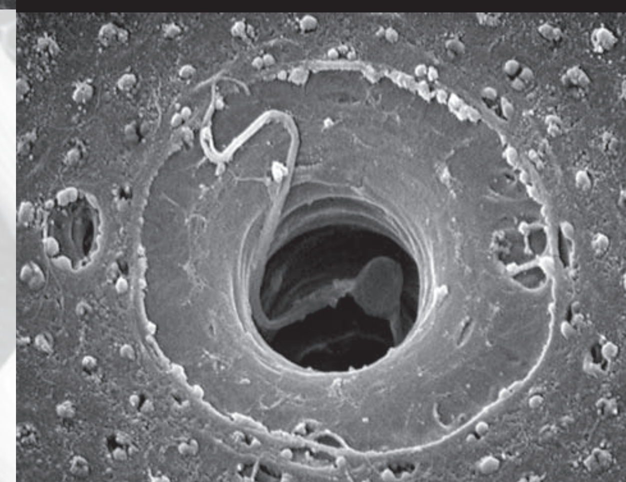
COOL FACTS

Most pelagic eggs (eggs that float in water) are small and smooth.

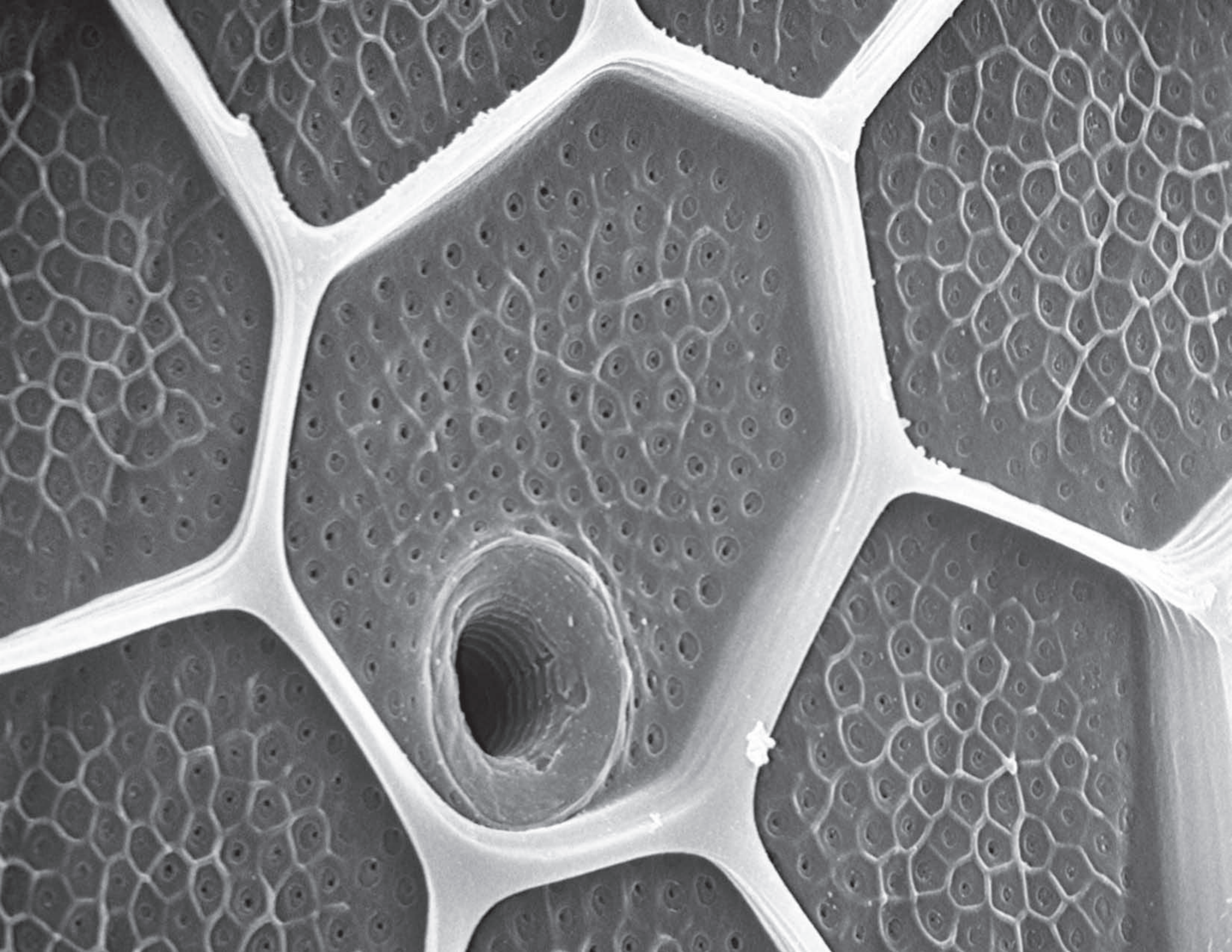
Demersal eggs (eggs that lie on the bottom or attach to rocks or plants) are usually large and sticky.

Some fish with demersal eggs guard them against predators.

Each fish egg has one micropyle (hole) where a single sperm enters to fertilize the egg.

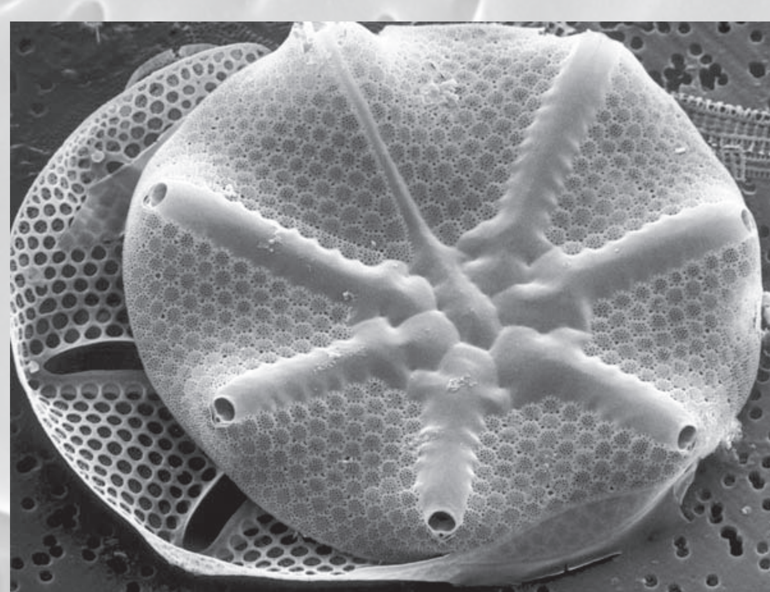


Design a fish egg pattern!



DIVERSE DIATOMS

There are thousands of species of diatoms with a diversity of shapes and patterns.



- Diatoms are tiny single-celled aquatic plants. Most diatoms are too small to be seen without a microscope.
- Diatoms can be found in almost every aquatic environment, from freshwater to saltwater.
- The two main groups of diatoms are centric (round shape) and pennate (elongated).
- Diatom cell walls are made of silica, with two parts that fit together like a box with a lid.

How are diatoms adapted to their environment?

- Holes in the diatoms' silica walls make them lighter and help them float. Diatoms need to be close to the sunlight at the water's surface for photosynthesis.
- Some diatoms form threadlike chains that can be seen with the naked eye. The chains provide protection from animals that eat diatoms.

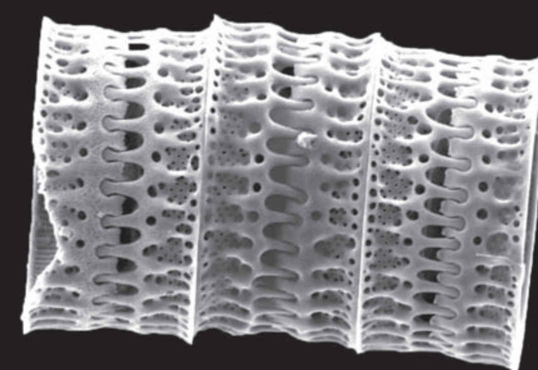
What is the role that diatoms play in the ocean?

COOL FACTS

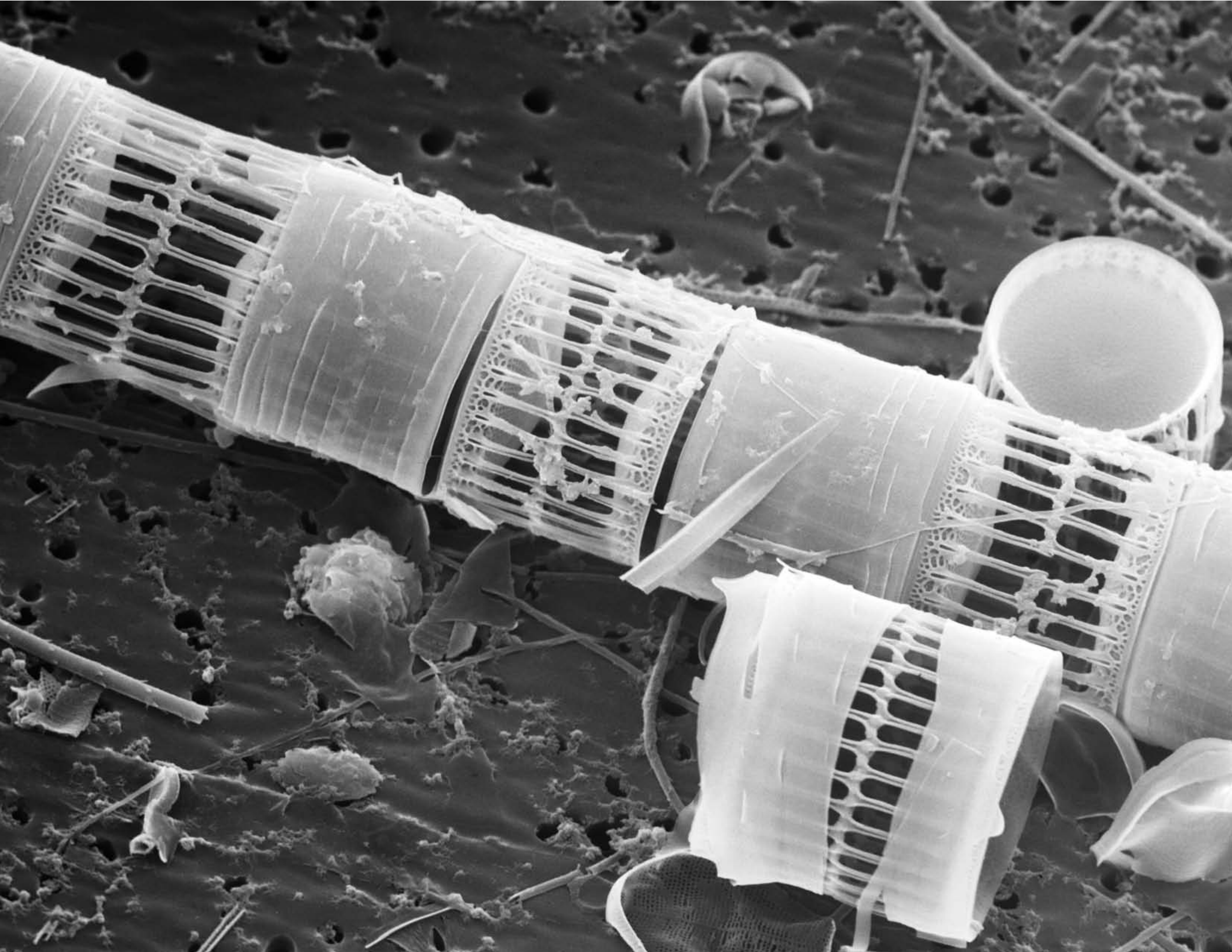
If you have taken a breath today, thank a diatom. Diatoms produce about 25% of the oxygen in the atmosphere!

Not all diatoms float. A few are sticky and can be found on rocks or the insides of fish tanks.

It is believed that there may be more than 100,000 living species of diatoms.

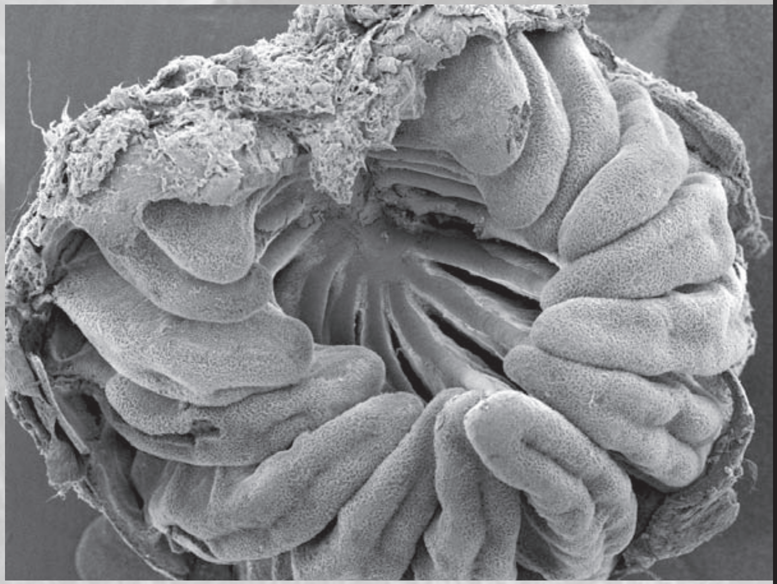


1. ***Make a plankton net!***
2. ***Plankton cards!***



SENSATIONAL SENSES

Fish use all of their senses (sight, smell, touch, hearing, taste, and electroreception) to survive. All fish use their noses to smell. These images show two ways that a halibut senses its surroundings.



- Inside the nose is a rosette made of several types of cells that can sense both natural and man-made substances in the water.
- Neuromasts are specialized sensory cells that allow fish to detect movement in the water. Fish use neuromasts to detect their neighbors when schooling, to avoid predators, and to find food.

How are fish adapted to their environment?

- **Body shape:** Torpedo-shaped fish tend to be fast swimmers who chase their prey. Fish that are flat like a pancake tend to live close to the ocean floor and wait for their prey to pass by.
- **Color:** Skin coloration and patterns that blend in with the habitat help fish hide from predators and surprise their prey.
- **Senses:** Sharks have a sense that people don't have; electroreception is the ability to sense electrical fields.

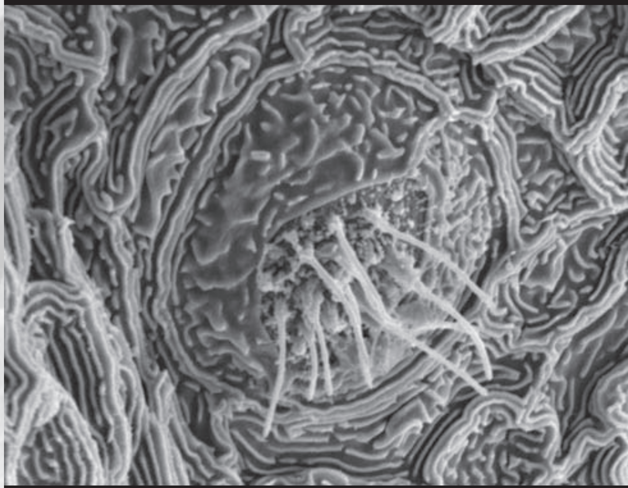
What other ways are fish adapted to their aquatic environment?

COOL FACTS

Fish don't use their nose to breathe. The nose is used only for smelling and is not connected to the mouth or gills.

Salmon use their superb sense of smell for navigation. Pollutants can damage their ability to smell, preventing them from completing their journey from the ocean to the stream where they hatched.

The neuromast below is from the 6-week-old halibut pictured on the front of the poster.



Smell your way home!